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DRAFT

SUMMARY REPORT

INVESTIGATION OF HOT STAMP

METHOD OF WIRE MARKING

FEBRUARY 20, 1964

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SUBJECT

- Report on Investigation of Hot Stamp  
Method of Wire Marking

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An investigation of the hot stamp method of wire marking has been completed. The purpose of the investigation was to determine the extent of degradation to the wire insulation caused by this process. This report presents the findings of the investigation and offers recommendations.

The information presented was obtained from various wire manufacturers, major contributors in the aero-space industry, insulation materials manufacturers and a marking machine manufacturer. In addition, an evaluation has been made of sample wires marked by different companies.

All information shows there is definite degradation to the insulation. The degree of degradation depends upon all the variables involved in the wire marking process viz. machine settings, wire gage, insulation material, operator training and control, degree of quality inspection applied, wear of marking type, etc. There is also information to indicate a possible continuing degradation to the marked area during aging.

It is significant to note that MSFC Cable and Harness specification No. 75M50741 states, "Damage to insulation due to accidentally applied heat is sufficient reason for rejection and replacement of the wire or cable." It is basic to the hot stamp method of wire marking that the heated type characters are impressed into the wire insulation.

A search of NASA and military specifications shows there is no applicable specification to apply to control this condition. MIL-W-16878 is the specification to control the manufacture of wire but does not apply after the wire is modified by marking. The military specification found to reference marking requires only that the marking is permanent and legible.

The equipment most commonly used for hot stamp marking is made by the Kingsley Machine Company. It is generally agreed this is as good equipment as is available for this process. Samples of wire marked with the Kingsley Machine have been obtained from three sources. Three types of insulating material, PVC, FEP Teflon, and combination materials were represented in the samples. In all cases the depth of the marking impression reduces the insulating wall thickness by a minimum of 25% up to 50% as determined by cross section and microscopic examination.

Samples of wire were marked on the Kingsley Machine as installed by G. E., A. S. D. Manufacturing. PVC wire was marked using the Kingsley recommended machine settings. The marking appeared permanent and legible. The marked samples were subjected to dielectric strength and insulation resistance tests measured under water as specified by MIL-W-16878D. The first two lots of wire failed both tests. An additional lot was run with reduced heat and pressure settings on the marking machine. The wire passed dielectric strength and insulation resistance tests; however, cross section and microscopic examination showed the depth of the marking impression to be up to approximately 70% of the wall thickness.

FEP Teflon wire was also marked using G. E.'s Kingsley Machine. The pressure and dwell time were reduced to a minimum that would yield an acceptable mark. Cross section showed a reduced insulation thickness of up to 50% of the wall thickness.

TFE Teflon was marked using the G. E. "Kingsley" Machine. After marking, a heat setting oven was used to sinter the marking for permanency. The depth of the marking impression before heat setting was approximately .002 inches. After heat setting the depth of the impression was not discernible. Exposure to the heat set operation must be carefully controlled to prevent damage to the insulation. The tests as made resulted in crystallization of the Teflon as evidenced by an increased stiffness of the wire after heat setting. It is not known if the crystallization affects the insulation quality.

Telephone discussions with technical representatives of various wire manufacturers (five companies) reveal that the degradation is generally recognized. Their recommendations were to purchase wire either color coded via striping or to have the wire manufacturers mark the wire during fabrication. This would assure compliance to specification and eliminate the need to damage the insulation further by processing. None of the wire manufacturers advised in favor of the hot stamp method and two companies strongly advised against it.

Five companies who are major contractors in the aerospace industry have been contacted. All companies use or have used the Kingsley Machine for marking wire. One company recognized a problem of insulation damage and discontinued use of the process. Of the remaining companies the only specification requirements are for legibility and permanency. There are no controls employed to limit the extent of the insulation damage other than visual inspection.

Literature describing various types of wire and its recommended usage has been obtained from wire and insulation manufacturers and from the wire users. The following points are brought out in this literature:

1. An outside coating is often used over the basic insulation. The purpose of the coating is to offer increased wear or abrasion strength. Hot stamp marking cuts through this coating.
2. Insulated wire cold flows if the insulation is subject to compression such as against another part or at a cabling tie. The cold flow action could further degrade the insulation at a marked area.
3. Environmental conditions can cause embrittlement and cracking of wire

## 3. (Cont.)

insulation. Previous damage to the insulation would contribute to this condition.

Discussion with the "Kingsley Machine Co." representatives shows that they do not consider the degradation to be a problem. They feel that the depth of the marking impression can be controlled adequately by proper set up and use of their machines. They generally recognize that the depth of the marking impression will be from .001 to .003 inches.

Because of the damage to insulation caused by the hot stamp process, it is recommended that this method be avoided wherever possible. When it is found necessary to identify wires and if the hot stamp process is used, the specifications should require a dielectric strength and insulation resistance test to meet the requirements of MIL-W-16878, after marking.

As an alternate to hot stamp wire marking, the following are suggested methods of wire identification:

1. A short length of sleeve carrying the required marking can be placed over the wire.
2. Purchase of colored wire and a color code method of identification.
3. Ink printing of the desired marking by the wire manufacturer.
4. Identifying adhesive markers.
5. Employ ink stamp method of wire marking wherever possible.



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